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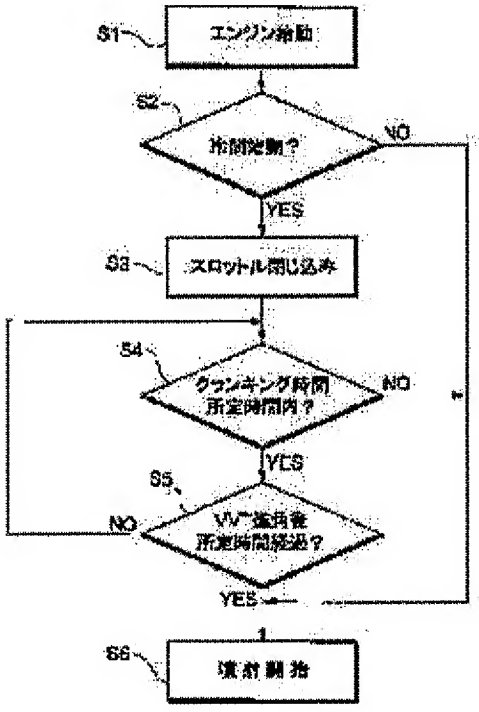
(54) CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE AND VEHICLE EQUIPPED WITH THE DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a control device for an internal combustion engine to improve exhaust performance at starting in an internal combustion engine equipped with an adjustable valve mechanism, and to provide a vehicle equipped with the device.

SOLUTION: The overlapping of intake and exhaust valves is set to exceed the prescribed valve at a cold starting by an adjustable valve mechanism, and the internal combustion engine is rotated with the number of idle rotations by a start motor. Fuel is supplied after the negative pressure in a combustion chamber reaches prescribed negative pressure. This action enables to prevent fuel from sticking on the well surface of a fuel chamber and to improve exhaust performance.



CLAIMS

[Claim(s)]
[Claim 1]Are a good change valve system and a start-up motor a control device of an internal-combustion engine which it has, and at the time of start up between the colds. Overlap of an induction-exhaust valve is set up according to said good change valve system beyond a predetermined value, A control device of an internal-combustion engine which performs control which starts fuel supply after judging with having rotated said internal-combustion engine with abbreviated idle rpm of said internal-combustion engine by said start-up motor, and negative pressure of a combustion chamber of said internal-combustion engine having reached predetermined negative pressure after that.
[Claim 2]A control device of the internal-combustion engine according to claim 1 which performs control which said internal-combustion engine is provided with an electronically controlled throttle, and it closes a throttle opening from usual till before a fuel-supply start at least, adjusts it to a side on the occasion of start up between the colds, and returns said throttle opening after predetermined time after a fuel-supply start usual.
[Claim 3]A control device of the internal-combustion engine according to claim 1 or 2 which judges whether said internal-combustion engine has a negative pressure sensor which detects negative pressure of a combustion chamber or an inlet pipe, and negative pressure of said combustion chamber reached said predetermined negative pressure based on a detection value of said negative pressure sensor.
[Claim 4]Said good change valve system has a switching condition sensor which detects a switching condition of an induction-exhaust valve, A control device of the internal-combustion engine according to claim 1 or 2 which controls by judging with whether negative pressure of said combustion chamber reached said predetermined negative pressure having reached said predetermined negative pressure when specified time elapse was carried out, after a switching condition of an induction-exhaust valve detected by said switching condition sensor reached a

predetermined state.

[Claim 5]A control device of the internal-combustion engine according to claim 1 or 2 which controls by judging with whether negative pressure of said combustion chamber reached said predetermined negative pressure having reached said predetermined negative pressure when specified time elapse was carried out, after setting up overlap of said induction-exhaust valve by said good change valve system beyond said predetermined value.

[Claim 6]Vehicles driven by a driving source besides the above until it is the vehicles carrying a control device of the internal-combustion engine according to any one of claims 1 to 5, it has other driving sources which may drive vehicles with said internal-combustion engine and fuel supply to said internal-combustion engine is started.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]Especially this invention relates to the vehicles which carry the control device of an internal-combustion engine and it provided with a good change valve system and a start-up motor about the control device of an internal-combustion engine.
[0002]
[Description of the Prior Art]In order to raise fuel consumption and discharging efficiency, the internal-combustion engine provided with the good change valve system which carries out variable control of the opening and closing timing of an induction-exhaust valve according to an operating condition is known.
[0003]In the fuel injection control device of an internal-combustion engine provided with such a good change valve system, the art currently indicated by JP,9-195840,A permits fuel injection, when the valve timing of an induction-exhaust valve reaches valve timing at the time of start up.
[0004]At the time of the restart after an internal-combustion engine stops by an engine stall etc. in the state where the tooth-lead-angle value of an inlet valve is large, and the valve overlap in which both induction-exhaust valves are opened states is specifically large. Fuel is injected after setting it as the state where the tooth-lead-angle value of the small inlet valve of a valve overlap is small. This prevents fuel from blowing excessively to an exhaust side at the time of restart, and it is indicated that discharging efficiency can be raised.
[0005]
[Problem(s) to be Solved by the Invention]However, in order according to this art to delay a tooth lead angle and to restart an internal-combustion engine as a state where a tooth-lead-angle value is small, the negative pressure of the combustion chamber at the time of restart becomes small. As a result, there is a possibility that the fall of the exhaust performance by

fuel adhering to the wall surface of a combustion chamber may occur.
[0006]This invention is made in view of the above-mentioned problem, and let it be a technical problem to provide the vehicles which carry the control device of an internal-combustion engine and it which raise the discharging efficiency at the time of start up in an internal-combustion engine provided with a good change valve system.
[0007]
[Means for Solving the Problem]In order to attain an aforementioned problem, a control device of an internal-combustion engine concerning this invention, Are a good change valve system which carries out variable control of the opening and closing timing of an induction-exhaust valve, and a start-up motor which can be driven more than idle rpm a control device of an internal-combustion engine which it has, and at the time of start up between the colds. Overlap of an induction-exhaust valve is set up according to a good change valve system beyond a predetermined value, an internal-combustion engine is rotated at number of rotations near idle rpm by a start-up motor, and after judging with negative pressure of a combustion chamber of an internal-combustion engine having reached predetermined negative pressure after that, control which starts fuel supply is performed.
[0008]According to this invention, overlap of an induction-exhaust valve is set up according to a good change valve system beyond a predetermined value, before fuel supply, an internal-combustion engine is made to drive just like a vacuum pump, and negative pressure of a combustion chamber can be raised by rotating an internal-combustion engine with idle rpm by a start-up motor. And while being able to secure sufficient negative pressure in a drive of an internal-combustion engine and preventing adhesion of fuel to an internal surface of a combustion chamber by starting fuel supply and starting an internal-combustion engine after reaching predetermined negative pressure, it can be stabilized, fuel can be burned and discharging efficiency improves. This is effective especially at the time of start up between the colds to which the performance of a processing catalyst of exhaust air is falling.
[0009]It is preferred to perform control which this internal-combustion engine is provided with an electronically controlled throttle, and it closes a throttle opening from usual before a fuel-supply start, adjusts it to a side on the occasion of start up between the colds, and returns a throttle opening after a fuel-supply start to normal. By closing a throttle opening at the time of the above-mentioned pump drive, and adjusting to a side, negative pressure of a combustion chamber can be early raised more to a predetermined value.
[0010]As for a judgment of whether negative pressure of a combustion chamber reached a predetermined value, it is preferred to have further a negative pressure sensor which detects negative pressure of a combustion chamber or an inlet pipe, and to judge based on a detection value of this negative pressure sensor. Or it has a switching condition sensor which detects a switching condition of an induction-exhaust valve in a good change valve system, and after a

switching condition of an induction-exhaust valve detected by this switching condition sensor reaches a predetermined state, when specified time elapse is carried out, it may control by judging with having reached said predetermined negative pressure. After overlap of a predetermined induction-exhaust valve is attained, it is because negative pressure of a combustion chamber can be made into sufficient negative pressure by continuing the above-mentioned pump drive predetermined time. Or after setting up overlap of an induction-exhaust valve by a good change valve system beyond a predetermined value, when specified time elapse is carried out, it may control by judging with having reached predetermined negative pressure. After change of opening and closing timing is directed to a good change valve system from a control device, by the time opening and closing timing of an induction-exhaust valve is actually changed, a time lag will exist, but the time lag can be predicted and prediction of negative pressure of it is also usually attained.

[0011]According to this invention, by the time an internal-combustion engine starts at the time of start up between the colds, there will be this 1 to several seconds case. Therefore, as for vehicles carrying a control device of an internal-combustion engine concerning this invention, it is preferred to drive vehicles by other driving sources until it has other driving sources which may drive vehicles with an internal-combustion engine and fuel supply to an internal-combustion engine is started.

[0012]

[Embodiment of the Invention]Hereafter, with reference to an accompanying drawing, the suitable embodiment of this invention is described in detail. In order to make an understanding of explanation easy, in each drawing, to the same component, the same possible reference number is attached and the overlapping explanation is omitted.

[0013]Drawing 1 is a lineblock diagram of the main part of a hybrid vehicle provided with the control device of the internal-combustion engine concerning this invention. This hybrid vehicle is provided with the engine (internal-combustion engine) 1 driven in response to supply of fuel from the fuel tank which is not illustrated, and that output shaft is connected to the power dividing device 2 using an epicyclic gear etc. The power dividing device 2 is connected to the generator (dynamo) 3 and the motor (electric motor) 4, and the driving force of the engine 1 has composition transmitted to the generator 3, the motor 4, or its both by the power dividing device 2. The driving wheel 6 of vehicles is connected to the axis of rotation of the motor 4 via the reduction gears 5. And the generator 3 and the motor 4 are electrically connected to the storage battery 8 via the inverter 7. And this hybrid vehicle is provided with the engine control unit (ECU) 9 which controls a driver system.

[0014]Next, the detailed composition of the engine 1 is explained. The electronically controlled throttle 11 to which an opening is controlled by ECU9 from the atmosphere side by the inlet pipe 10 connected to the engine 1, the negative pressure sensor 12 which detects the negative

pressure in the inlet pipe 10, and the injector 13 which supplies fuel are arranged, and it results in the suction valve 14. The suction valve 14 is driven by the cam 15, and this cam 15 is connected to the variable valve timing mechanism (VVT) 16 which adjusts the opening and closing timing of the suction valve 14 with directions of ECU9. And the cam position sensor 17 is attached to the cam 15. VVT currently indicated by JP,10-227236,A can be used for VVT16, for example. Drawing 2 is a figure explaining operation of VVT16. The length of a valve overlap which both the suction valve 14 and the exhaust valve 31 are opening by adjusting the timing which the suction valve 14 opens (valve lift) is adjusted. It will call, if the case (equivalent to shifting the valve-lift curve of the suction valve 14 in a figure on left-hand side) where open earlier than suction valve 14 adjustment-before, and a valve overlap is lengthened hereafter is adjusted to the tooth-lead-angle side, Conversely, if the case (equivalent to shifting the valve-lift curve of the suction valve 14 in a figure on right-hand side) where open later than adjustment before and a valve overlap is shortened is adjusted to the angle-of-delay side, it will call.

[0015]The spark plug 21 is arranged in the combustion chamber 20. Reciprocating movement of the piston 23 in the cylinder 22 is transmitted to the power dividing device 2 mentioned above via the connecting rod 24 and the crankshaft 26. The water temperature sensor 24 which detects cooling water temperature is attached to the crank case which constitutes the cylinder 22.

[0016]The exhaust pipe 30 is connected to the point of the exhaust valve 31 at the exhaust side of the combustion chamber 20, and the exhaust valve 31 shines in the composition driven by the cam 32.

[0017]In such a hybrid car, efficient operation is attained by changing distribution of driving force according to the power dividing device 2. By a high rpm, the engine 1 is efficient and specifically the motor 4, Since the efficiency in a low rpm is good, it runs mainly by the motor 4 at the time of low speed running, and the storage battery 8 is usually charged at the time of a run while assisting driving force by the motor 4 using the electric power which drove and generated the generator 3 at a part of driving force of the engine 1. At the time of a heavy load, electric power is supplied from the storage battery 8, and the assist force of the motor 4 is reinforced. At the time of braking, kinetic energy is collected as electric power by driving the motor 4 by the driving wheel 6, and generating electricity.

[0018]Next, the operation at the time of start up is explained. The control device of the internal-combustion engine concerning this invention solves the technical problem mentioned above, and has the feature in the operation at the time of this start up. Drawing 3 is a flow chart at the time of start up, and drawing 4 is a suction valve tooth lead angle at the time of start up, intake pipe negative pressure, and a graph that shows transition of an engine speed value. In the following operations, especially, as long as it is unstated, ECU9 controls the operation of each

component.

[0019]First, with the electric power which adjusted the power dividing device 2, connected the generator 3 and the engine 1, controlled the inverter 7 by Step S1, and was stored in the storage battery 8, the generator 3 is rotated, the number of rotations of the engine 1 is raised to about 1300 rpm, and the engine 1 is started. And a tooth-lead-angle setpoint signal is emitted so that the tooth lead angle of the suction valve 14 may be 25 degrees. Thereby, a valve overlap is set up for a long time. The tooth-lead-angle value of the actual suction valve 14 changes later than a setpoint signal in $deltat_a$ (drawing 4 about 1 second), as a thin dashed line shows to drawing 4.

[0020]In Step S2, it is judged whether it is start up between the colds. The cooling water temperature detected with the water temperature sensor 24 specifically in -10 **-70 **. Judge with it being start up between the colds, when the catalyst imitation temperature which is a predicted value by calculation of the temperature of the catalyst for exhaust air purification is less than 500 **, and it progresses to Step S3, When not less than 70 ** or catalyst imitation temperature is not less than 500 **, cooling water temperature skips future processings, injects fuel from the injector 13, starts combustion in the combustion chamber 20 of the engine 1, and starts operation of the engine 1.

[0021]When it judges with it being start up between the colds, in Step S3, a throttle opening is closed for the electronically controlled throttle 11 from the time of the usual starting (for example, 5 degrees of throttle openings) (for example, 2 degrees of throttle openings). Thereby, the pressure of the inlet pipe 10 and the combustion chamber 20 decreases, and the negative pressure which is a difference with atmospheric pressure as shown in drawing 4 increases (the absolute value of the negative pressure which has a negative value becomes large).

[0022]In step S4, it is detected whether cranking time is in predetermined time. When the output of the cam position sensor 16 is supervised and the delay ($deltat_a$) over a setpoint signal specifically becomes 5 seconds or more, it judges with VVT failure etc. having occurred, future processings are skipped, and injection of fuel is started. In being other, it goes on to Step S5.

[0023]If predetermined time $deltat_b$ (here 500 ms) progress is carried out after the tooth-lead-angle value which supervised the output of the cam position sensor 16 and asked for it from the detected cam positions in Step S5 exceeds predetermined threshold $theta_{th}$ (here 20 degrees), it will shift to Step S6, In being other, it returns to step S4. If it predetermined-time-delta-t--$_b$-passes after a tooth-lead-angle value exceeds $theta_{th}$, intake pipe negative pressure will reach sufficient negative pressure P_{th} (about -70kPa) which may burn thoroughly, without

fuel adhering to the wall surface of a combustion chamber. After reaching at this time, as shown in Step S6, operation of the engine 1 is started by injecting fuel from the injector 13. According to this invention, the discharge of NMHC (nonmethane hydrocarbon; Non Methan Hydro Carbon) was able to be reduced about 20% with LA-4 mode measured value in 7.5mg (0.012 g/mile)/km to 6.2mg (0.010 g/mile)/km.

[0024]Since time t_1 until the engine 1 drives is needed for 2 to 3 seconds as shown in drawing 4, it is preferred to make vehicles drive by the motor 4 in the meantime.

[0025]After a start adjusts the electronically controlled throttle 11 so that it may become the optimal air-fuel ratio. At this time, when it returns slowly over 1 or 2 seconds, change of the combustion state of the engine 1 can be suppressed, the smooth engine 1 can be started, and it is desirable.

[0026]Although it judged whether engine negative pressure would have reached sufficient P_{th} from the output of the cam position sensor 17 in the above explanation, it may be judged whether, of course, the value of the negative pressure sensor 12 has reached threshold P_{th}. Or in order to simplify a device, after emitting a tooth-lead-angle setpoint signal value, when specified time elapse is carried out, it may judge with having reached P_{th}.

[0027]According to this embodiment, in a parallel series type hybrid car, although the case where an engine is started with a generator has been explained to an example, an engine may be started by a motor. This invention can apply an engine besides the hybrid car of a parallel type or a series type also to the usual car which has a starting motor which can be driven above idle rpm.

[0028]

[Effect of the Invention]According to this invention, set up the overlap of an induction-exhaust valve with a valve good change mechanism beyond a predetermined value at the time of start up between the colds, and an internal-combustion engine is made to rotate with idle rpm by a start-up motor, as explained above, After the negative pressure of a combustion chamber reaches predetermined negative pressure, by supplying fuel, it is possible to prevent adhesion of the fuel to the wall surface of a combustion chamber, and to raise discharging efficiency.

[Translation done.]